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(54) [Name of Invention]: Semiconductor Wafer Cleaning Device

(57) [Summary]

[Purpose] To improve rising performance uniformly over the surface of a wafer while reducing the amount of chemicals used in a semiconductor wafer cleaning apparatus.

[Structure] A semiconductor wafer 2 is chucked on a wafer chuck 4. After this, a liquid chemical stopper 13 is caused by a liquid chemical stopper elevator 14 to form a tight seal with said semiconductor wafer 2. Next, a liquid chemical is sprayed from a liquid chemical nozzle 3 onto said semiconductor wafer 2. Said liquid chemical is held on said semiconductor wafer 2 to the height of said liquid chemical stopper 13. The microwaves from a magnetron 11 irradiate said liquid chemical accumulated on the surface of said semiconductor wafer 2, thereby increasing the temperature of said liquid chemical and cleaning the surface of said semiconductor wafer 2 thereby. After the wafer cleaning using said liquid chemical has been completed, said liquid chemical stopper 13 is lifted by said liquid chemical stopper elevator 14, and said liquid chemical runs off. Next said wafer chuck 4 spins, and clean water is dispensed from a rinse nozzle 1. Hence a clean water rinse is effected by the spinning of said semiconductor wafer 2 and a clean

water spray. Finally, said clean water spray is stopped and said semiconductor wafer 2 is spun at a high speed to dry said semiconductor wafer 2 to complete the process.

[INSERT FIGURE ON PAGE 181]

- [1] Rinse nozzle
- [2] Semiconductor wafer
- [3] Liquid chemical nozzle
- [4] Wafer chuck
- [11] Magnetron (microwave generator)
- [12] Hood
- [13] Liquid chemical stopper
- [14] Liquid chemical stopper elevator
- [15] Liquid chemical

[Range of Patent Claims]

- [Claim 1] A semiconductor wafer cleaning apparatus characterized by the provision of at least a liquid chemical stopper mechanism that holds a liquid chemical on a semiconductor wafer and a microwave generator used to increase the temperature of the liquid chemical that is held within said liquid chemical stopper mechanism.
- [Claim 2] The semiconductor wafer cleaning apparatus of Claim 1, characterized by the use of a heat lamp instead of the use of the microwave generator.
- [Claim 3] The semiconductor wafer cleaning apparatus of Claim 1 and Claim 2, characterized by the provision of a mechanism for transporting the semiconductor wafer, a mechanism for holding said semiconductor wafer on a chuck, a nozzle which produces a spray of the liquid chemical, and a nozzle which produces a spray of clean water.

[Detailed Explanation of the Invention]

[0001]

[Area of Application in Industry] This invention has to do with semiconductor wafer cleaning equipment in the cleaning processes in semiconductor manufacturing.

[0002]

[Prior Art] Recently there have been advances in semiconductor wafer cleaning equipment in order to improve their particle-removal capabilities, to reduce the amount of adhesion of metallic contaminants, and to insure uniform cleaning across the surface of the wafer.

[0003] Below, a figure will be used to present an example of this type of conventional semiconductor cleaning equipment. Figure 3 shows a schematic orthonormal view of a conventional wafer cleaning apparatus. In Figure 3, 1 is a water rinse nozzle, used to rinse semiconductor wafer 2 with pure water. 3 is a chemical nozzle, which is used to clean semiconductor wafer 2 with a liquid chemical. 4 is a wafer chuck, used to secure semiconductor wafer 2.

[0004] The operation of the conventional semiconductor wafer clean equipment structured as described above is explained below:

[0005] Firstly, semiconductor wafer 2 is affixed to wafer chuck 4 by a transport mechanism. Afterwards, a liquid chemical is sprayed from liquid chemical nozzle 3 while wafer chuck 4 is turning. After this, the liquid chemical spray is stopped and, instead, semiconductor wafer 2 is rinsed by a pure water spray from water rinse nozzle 1. After this, the water rinse is stopped and semiconductor wafer 2 is dried as it is spun. Finally, the wafer transport devices moves semiconductor wafer 2 from wafer chuck 4 and the clean is completed. (For example, see the disclosure report for Japanese Patent S 63-14434.)

[0006]

[The Problem That This Invention Attempts to Solve] The structure described above has a problem in that an extremely large amount of liquid chemical is used because the liquid chemical that is sprayed from liquid chemical nozzle 3 runs off of the surface of semiconductor wafer 2. Furthermore, if, for example, the clean is done using a mixture of sulfuric acid and hydrogen peroxide (used for the clean after removing photoresist), the temperature of the liquid chemical must be held in excess of 130°C, and thus when large amounts of the liquid chemical are used, heating the liquid chemicals becomes a problem. While methods are used for reusing the used liquid chemical by using recirculators, because these methods decrease the purity of the liquid chemicals, and are thus not suited for cleaning wafers.

[0007] The purpose of this invention is to take into account the problems described above in providing a semiconductor wafer cleaning device that reduces the amount of chemicals used in single-wafer cleaning equipment while increasing the wafer cleaning capability.

[0008]

[The Method for Solving the Problem] In order to achieve the objective described above, the semiconductor wafer cleaning device of this invention is equipped with a microwave generator or a heat lamp, and with a liquid chemical stopper mechanism for holding the liquid chemical on top of the semiconductor wafer.

[0009]

[Effects of this Invention] The structure described above holds a specific amount of liquid chemical on top of the semiconductor wafer, heats said liquid chemical using a microwave generator or a heat lamp, and thereby improves the cleaning capability uniformly over the semiconductor wafer surface while reducing the amount of liquid chemical used.

[0010]

[Example of Embodiment] One example of embodiment of the semiconductor wafer cleaning apparatus will be described below while referencing a figure. Figure 1 shows a schematic cross section of the semiconductor wafer cleaning apparatus in this example of embodiment of this invention. Explanations of 1 through 4 in Figure 1 are omitted because they are the same as in the conventional example in Figure 3. 11 is a magnetron that generates microwaves, 12 is a hood for insuring that the microwaves uniformly illuminate wafer 2, 13 is a liquid chemical stopper for holding a specific amount of liquid chemical on top of wafer 2, and is in the shape of a ring the size of the wafer. 14 is a liquid chemical stopper elevator device, which, after the cleaning process, causes liquid chemical stopper 13 to form a tight seal with semiconductor wafer 2 or lifts

said liquid chemical stopper 13, and functions to discharge the liquid chemical. 15 is the liquid chemical that is held on top of semiconductor wafer 2.

[0011] The operation of the semiconductor wafer cleaning device with the structure described above is as explained below.

[0012] First, the wafer transport mechanism transports semiconductor wafer 2 to the cleaning device of Figure 1. Next, wafer chuck 4 secures the back surface of semiconductor wafer 2. After this, liquid chemical stopper 13 is caused to form a tight seal with semiconductor wafer 2 by the action of the liquid chemical stopper elevator mechanism 14. Following this, the liquid chemical (for example, a solution of sulfuric acid and hydrogen peroxide) is sprayed onto semiconductor wafer 2 from liquid chemical nozzle 3. The liquid chemical accumulates on top of semiconductor wafer 2 until it reaches the height of liquid chemical stopper 13. A magnetron 11 produces a microwave at, for example, 2.45 GHz, in order to raise the temperature of the liquid chemical held on top of semiconductor wafer 2 by irradiating the liquid chemical held on top of semiconductor wafer 2. Similar to the effects of microwave radiation in a microwave oven, the temperature of the liquid chemical is increased, and the liquid chemical cleans the surface of semiconductor wafer 2. After the liquid chemical clean of the wafer has been completed, then liquid chemical stopper 13 is lifted by liquid chemical stopper elevator mechanism 14, and the liquid chemical runs off. Next, with liquid chemical stopper 13 removed from semiconductor wafer 2, wafer chuck 4 is caused to spin and pure water is sprayed from water rinse nozzle 1. Semiconductor wafer 2 receives a pure water rinse from the rotation of semiconductor wafer 2 and the pure water spray. Lastly, the pure water spray is turned off and semiconductor wafer 2 is spun at a high speed to complete the process by drying semiconductor wafer 2.

[0013] As described above, this example of embodiment is equipped with magnetron 11, which is a microwave generator device, and a mechanism for holding the liquid chemical on top of semiconductor wafer 2, making it possible to increase the cleaning capability at a high temperature uniformly across semiconductor wafer 2 and making it possible to reduce the amount of liquid chemical used.

[0014] Next will be explained, while referencing a figure, the second example of embodiment of this invention. Figure 2 shows a schematic cross-sectional representation of the semiconductor wafer cleaning apparatus of the second example of embodiment of this invention. In Figure 2, the difference with the first example of embodiment (Figure 1) is the method by which the liquid chemical held on top of semiconductor wafer 2 is heated.

[0015] In the first example of embodiment the heating is done by the microwaves that are generated in magnetron 11. In Example of embodiment No. 2 the heating is done using heat lamp 16.

[0016] Using this example of embodiment of this invention, semiconductor wafer 2 can be cleaned at a higher temperature with greater cleaning capability due to the effects of heat lamp 16 and the mechanism by which the chemical was held on semiconductor wafer 2, making it possible to provide high temperature/high uniformity while reducing the amount of liquid chemicals used. Moreover, this provides a pure clean without the damaging effects of microwaves, etc.

[0017]

[The Effects of this Invention] As described above, providing a microwave generator or a heat lamp along with a liquid chemical stopper mechanism that holds the liquid chemical on the surface of the semiconductor wafer, this invention makes it possible to provide high temperature/high uniformity cleaning to provide greater cleaning capabilities in a semiconductor wafer cleaning device able to reduce the amount of liquid chemicals used in the semiconductor wafer cleaning device.

[Simple Explanation of Figures]

[Figure 1] A cross-sectional view of the semiconductor wafer cleaning device in the first example of embodiment of this invention.

[Figure 2] A cross-sectional view of the semiconductor wafer cleaning device in the second example of embodiment of this invention.

[Figure 3] The schematic orthonormal view of the conventional semiconductor wafer cleaning device.

[Explanation of Symbols]

1. Water rinse nozzle
2. Semiconductor tray wafer
3. Liquid chemical nozzle
4. Wafer chuck
11. Magnetron (microwave generator)
12. Hood
13. Liquid chemical stopper
14. Liquid chemical stopper heater
15. Liquid chemical

[INSERT FIGURES ON PAGE 183]

[Figure 1]

[Figure 2]

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